



Products: R&S IMS, R&S NRP-Z91

## **R&S IMS**

### **Software Configuration and System Calibration** **according to IEC / EN 61000-4-6 (conducted Immunity)**

#### **Application Note**

This application note describes the software configuration, system calibration and test routine for EMC measurements according to the EMS standard IEC / EN 61000-4-6



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## 2 General Remark

The aim of this application note is to describe the software configuration, system calibration and test routine for a typical measurement setup using a CDN (Coupling-Decoupling-Network) as transducer according to EN61000-4-6. The use of the alternative transducers EM-Clamp and BCI Clamp (Bulk Current Injection Clamp) are also described.

The application note consists of three main parts:

- Software Configuration and System calibration
- First EMS test

There are four application notes covering the commercial standards IEC / EN 61000-4-3 and -6:

- 1SP31 / R&S IMS - Hardware Setup according to IEC / EN 61000-4-6 (conducted immunity)
- 1SP32 / R&S IMS -Hardware Setup according to IEC / EN 61000-4-3 (radiated immunity)
- 1SP33 / R&S IMS - Software Configuration according to IEC / EN 61000-4-6 (conducted immunity)
- 1SP34 / R&S IMS - Software Configuration according to IEC / EN 61000-4-3 (radiated immunity)

**Note:**



*This application note is based on the hardware setup described in application note 1SP31.*

**Note:**



*To carry out measurements according to the EMC standards requires detailed knowledge of these standards and EMC practice, which can not be covered by this application note.*

## 3 Software Configuration and System Calibration

### 3.1 General Topics

The R&S IMS Operating System is a very powerful tool for EMC measurements. Therefore the experienced user has many possibilities for adaptation of the different settings according to his needs. Nevertheless most of the settings are preconfigured and need not to be changed for standard tests described in this application note.

You are guided through the configuration step by step in this manual. In case you need further information please refer to the R&S EMC32 manuals or use the online help by pressing F1.

The R&S IMS Operating System has to be installed and configured. The main steps are:

- Software and driver installation
- Configuration of hardware
- Calibration of signal paths
- Calibration of transducers
- Carrying out the first EMS test

### 3.2 Installation of R&S IMS Operating System

**Note:**



***Do not plug in the R&S IMS before you have installed the USB Windows device drivers and when requested to do so in the subsequent instructions.***



***For measurements always connect the R&S IMS to the PC first and switch it on before starting the R&S IMS Operating System.  
Always close the software first before switching off the R&S IMS.***

Steps for the installation of the R&S IMS Operating System, which bases on R&S EMC32:

- Insert R&S EMC32-CD ROM

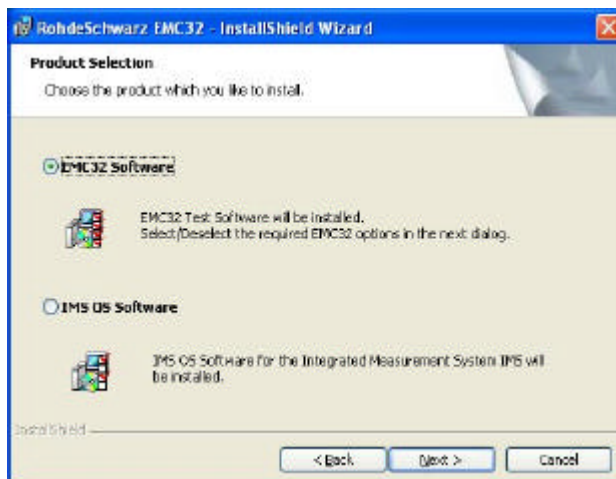
- The following screen appears:



Choose Install R&S IMS OS Software

Remark: It can also be started manually from the CD-ROM with HTMLView.exe

- Choose Install R&S IMS OS Software



- Complete the installation

- Install all the five USB drivers listed in the lower area of the start screen.

HTML-View - IMS Installation

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# EMC32

EMC Measurement Software  
IMS Installation

Home  
Installation  
**IMS Installation**  
Device Support  
Update  
Manuals  
Requirements  
Support  
Terms of Use  
Training  
Registration

V6.10

The IMS Operation System Software bases on the EMC32 platform. The following section describes the installation of the software on the control PC.

**Before you start the installation of IMS OS you should first read the following documents:**

- > R&S IMS Integrated Measurement System Manual
- > [System Requirements](#)
- > Microsoft USB Patch KB822603 for Windows XP, if SP2 is not installed. [English / German](#)

**Note:**  
Do not plug-in any USB device before you have installed the IMS OS Software and the required USB device drivers.

Install IMS OS Software

Install TMS Generator Driver

Install TMS Control Driver

Install NRP-Toolkit Software

Install Spectrum Analyzer Driver

Install IMS Control USB Driver

Install NRP-Z91 Driver

**Installation of Bonn Amplifier USB Device Driver:**

The installation of this devices uses the Windows USB Plug&Play support. Therefore you must connect now the IMS to the USB port of you PC and switch the IMS device into the Standby Mode. Windows will detect the new devices and will ask for a location to install the device drivers. After this the device driver installation is done automatically.

- Bonn USB Amplifier: select the following folder from the CD "[SystemDrivers\BonnUsb](#)"

**Post Installation Steps:**

- Install National Instruments GPIB hardware and driver (option IMS-B4)
- Run the Configuration Wizard in EMC32 to configure IMS OS for your test setup.

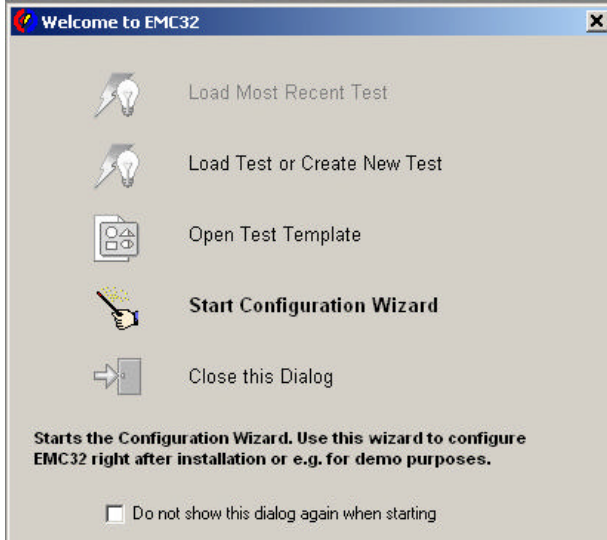
**Note:**



*The installation of the Windows USB device drivers has to be carried out in two phases. The first phase is completed after installing the above listed drivers. The second installation phase starts, when the R&S IMS is connected and powered the first time (installation of meM-PIO and amplifier device).*

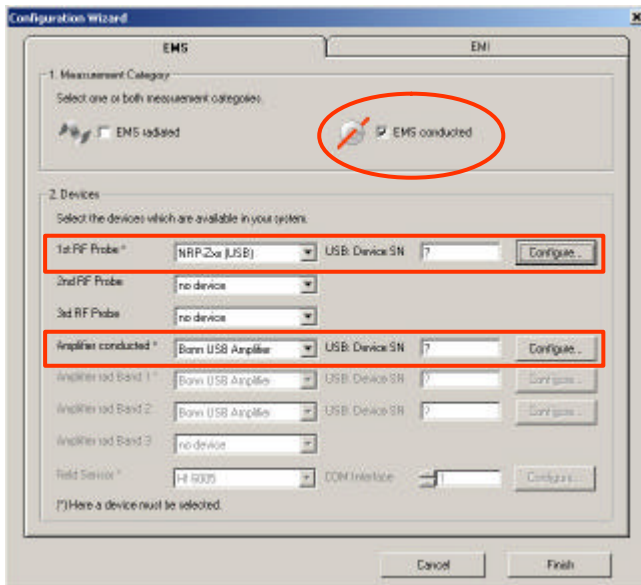
### 3.3 Configuration of Hardware

- Start EMC32  
Remark: The R&S IMS operating system is a special version of the EMC software R&S EMC32.
- Choose “Configuration Wizard” at the start window



Remark: The configuration wizard can also be started via the menu entry:  
Extras – Wizards – IMS Configurator

- Configure EMS



Remark: Settings for the use of one NRP-Z91 are preconfigured. No adjustments are necessary.

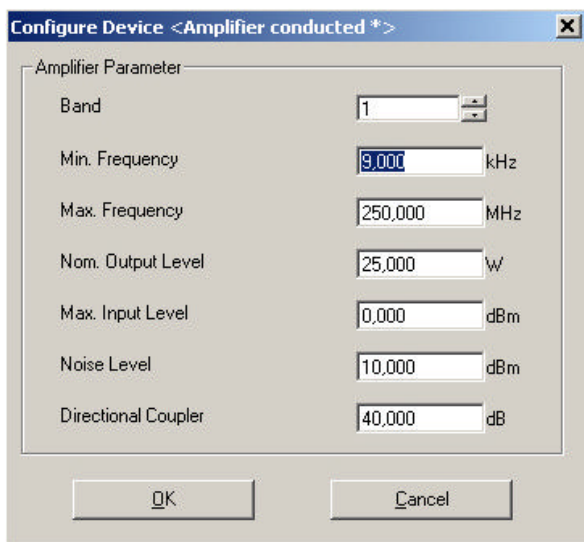
- Configuration of Amplifier conducted:

Fill in the serial number of the amplifier, which is found on the test protocol of the amplifier in the field USB Device SN. Any extensions by dash are left out. <unklar formuliert, Beispiel?>

Remark: If only one amplifier is used in the system, the USB device SN will be detected automatically.

Press “Configure”





The values are preconfigured for the internal power amplifier of the R&S IMS v14. In case of an external amplifier please adjust these data according to its specifications.

- Now, after the hardware configuration is completed close the software.
- Connect the R&S IMS to the PC and switch it on.
- Restart the R&S IMS Operating System (Icon “EMC32”)
- R&S IMS hardware will be detected and the USB drivers for the meM-PIO and the amplifier device will install automatically from the CD-ROM.

It is recommended to carry out a check of the equipment via menu Extras → Self Check → Test All. It is checked, if all the equipment is available and can be addressed properly. The question mark in the SN field will be replaced by the device SN.

### 3.4 Calibration of Signal Paths for Conducted Measurements

All RF paths should be calibrated in advance. This makes it easy to replace cables later. Then only the calibration for this new cable is necessary and not for the complete system with maybe different transducers.

The calibration of the signal paths consists of two steps:

- Normalisation measurement without cable
- Measurement of attenuation with cable and switching

Remark: All switching of the paths are automatically preconfigured in the software for these configurations. They need not to be changed.

Remark: If option R&S IMS-B3 is installed, the interlock contact must be closed for this measurements.

#### 3.4.1 Calibration of Signal Paths for CDN with Internal Amplifier (R&S IMS v14)

The following signal paths have to be calibrated:

- Generator-Amplifier1
- Amplifier1-RFSensor1(FWD)

- Amplifier1-RFSensor1(REV)
- Amplifier1-CDN
- CAL Adaptor – RFSensor1

### **3.4.1.1 Import of Attenuation Files**

For the first three signal paths in the table above the cables are delivered with the R&S IMS. These paths cannot be calibrated without opening the R&S IMS. The attenuation correction tables are therefore included in the CD-ROM as files. To import these tables proceed as follows:

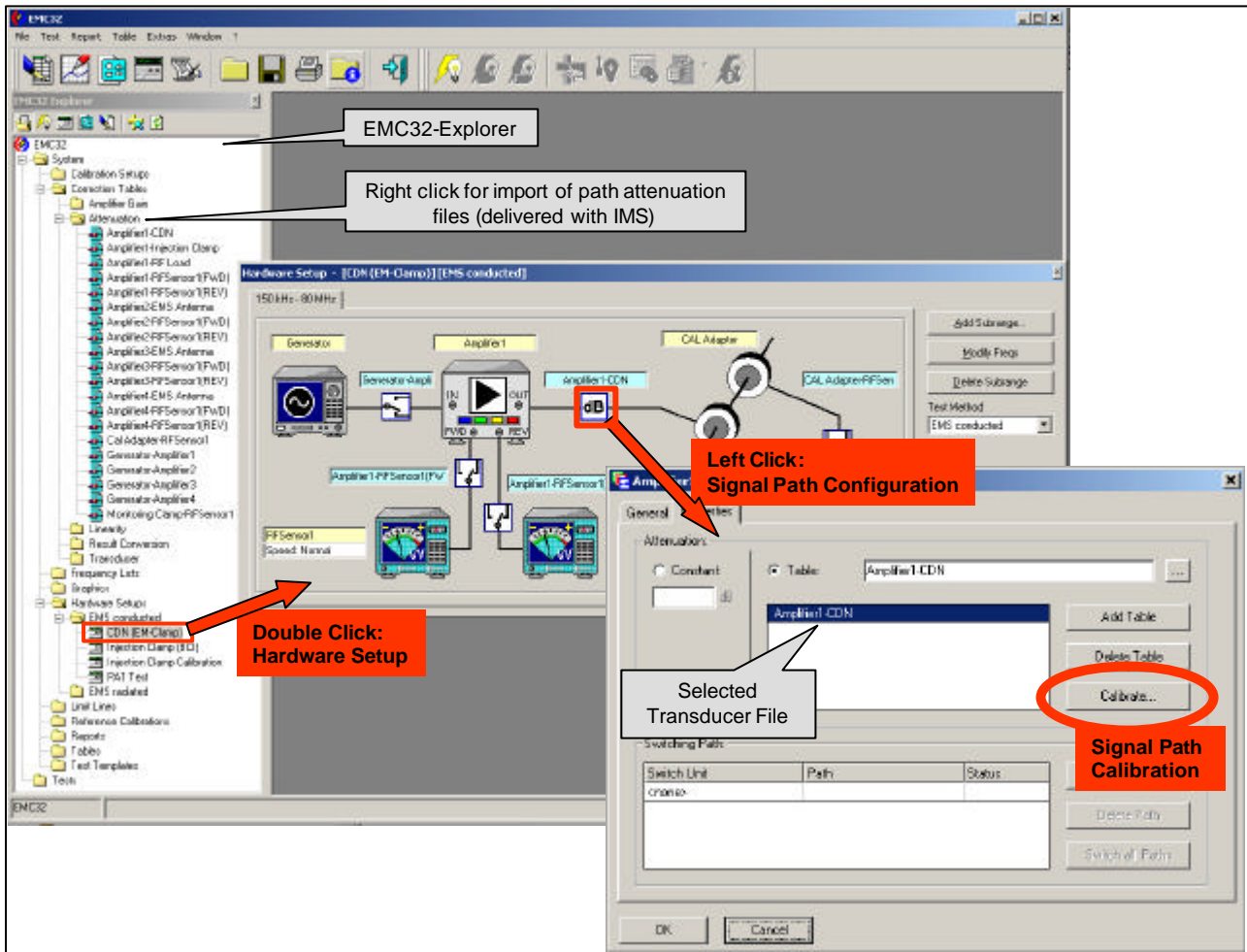
1. In the EMC32 Explorer expand the tree system - Correction Tables - Attenuation.
2. Right click on the Attenuation entry and select Import from the popup menu.
3. A file selection dialog opens. Select the required table and import it by clicking the Open button.
4. Carry out steps 2 and 3 for all three of the above mentioned tables.

### **3.4.1.2 Measurement Procedure:**

The path Amplifier1-CDN is calibrated via measurement:

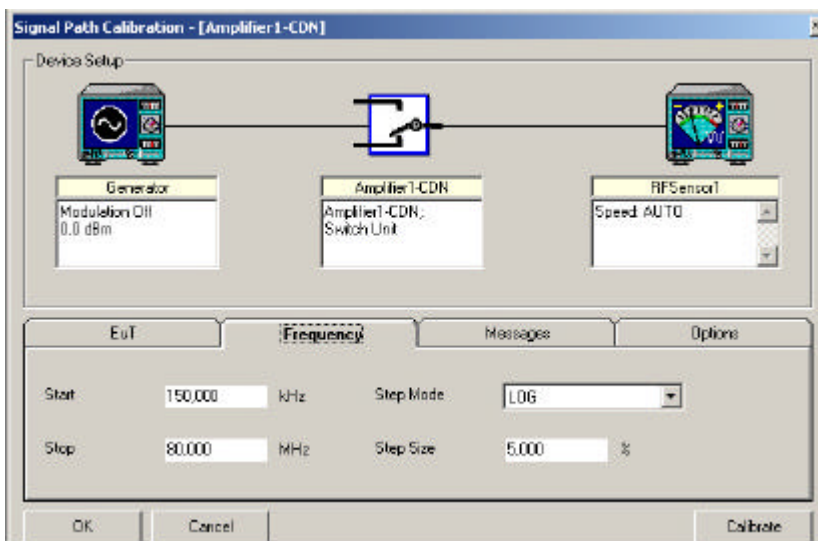
- Open menu Hardware Setups – EMS Conducted in the EMC32 Explorer.
- Double click on CDN (EM-Clamp). Now the hardware setup is displayed.
- Click on the connection between amplifier and CDN  
Remark: The settings for this path (attenuation, settings for switching) are shown
- Click the Calibrate button





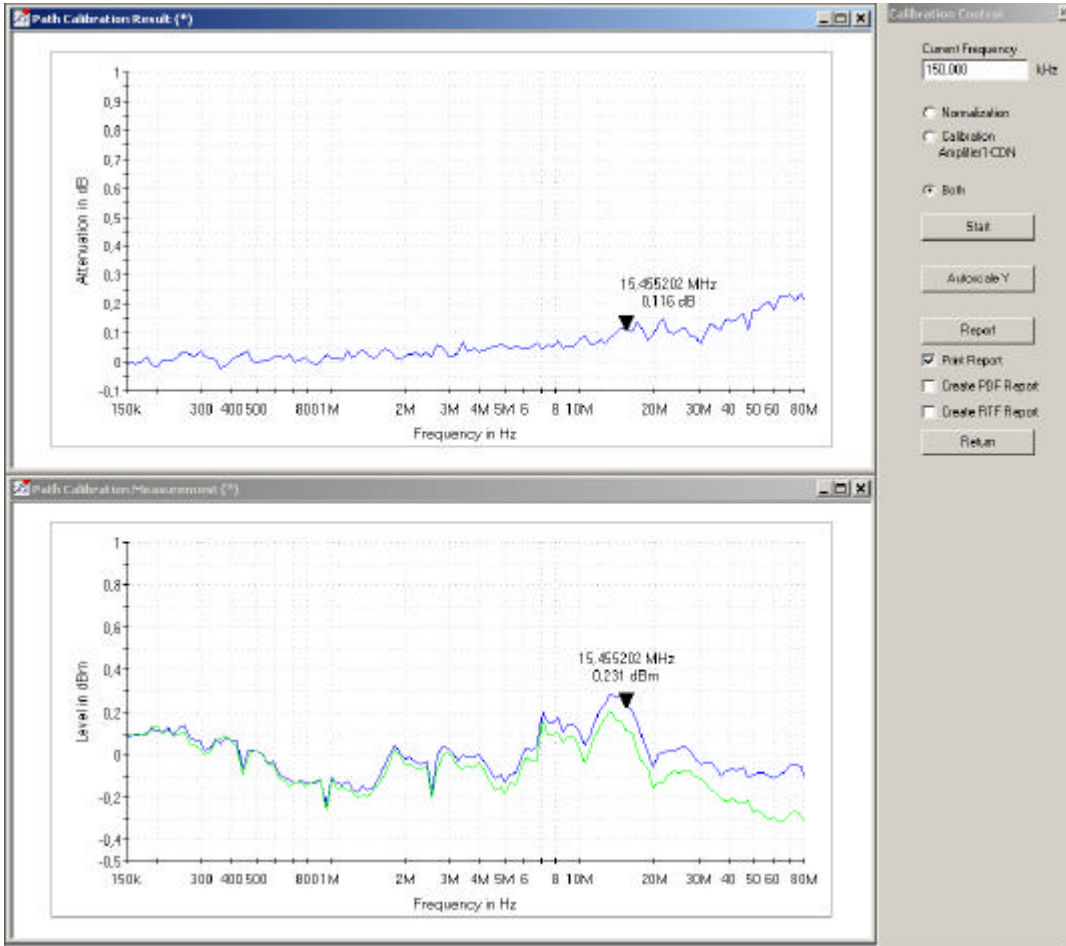
Cable Calibration CDN, step 1

- In the next step the calibration parameters can be set.  
Remark: All the settings need not to be changed for the standard setups. They should only be changed by experienced users.



Cable Calibration CDN, step 2

- Click Calibrate button
- Create the calibration file by the save button  
(Remark: It is recommended to use the proposed name of the signal path)
- Now the system is ready for calibration measurement.  
Connect the power sensor to connector X1 (RF OUT1).



Cable Calibration CDN, step 3 (Measurement Menu)

- Click Start for normalization measurement
- Connect all the cables and accessories of the path except the 6 dB attenuator between X1 (RF OUT1) and the power sensor.
- Click start for path calibration
- Click Return and save new calibration values.
- Repeat the procedure for path CAL Adaptor – RFSensor1. Use the following connections for setup:

Signal Path	Setup Normalisation Measurement	Setup Calibration Measurement	
		Signal Path	Power Sensor
CAL Adaptor- RFSensor1	Power Sensor to X1 (RF OUT1)	between X1 (RF OUT1) and X10 (MON IN)	Power Sensor to X11 (FWD)



**Tip:**  
In case of fixed installation of the cabling the connection points may be too far away for direct connection of the power sensor. In this case you can use extension cables. The same cable has to be inserted during both measurements, normalisation and path

calibration.

### 3.4.2 Calibration for Alternative Hardware Setups

#### 3.4.2.1 Calibration Signal Paths for CDN with External Amplifier

Follow the instructions of the measurement procedure in chapter 3.4.1.2.

Choose the corresponding path in the hardware setup menu and use the following connections for calibration:

Signal Path	Setup Normalisation Measurement	Setup Calibration Measurement	
		Signal Path	Power Sensor
Generator – Amplifier1	Power Sensor to X1 (RF OUT1)	between X1 (RF OUT1) and Power Sensor	
Amplifier1- RFSensor1(FWD)	Power Sensor to X1 (RF OUT1)	between X1 (RF OUT1) and X4 (FWD1)	Power Sensor to X11 (FWD)
Amplifier1- RFSensor1(REV)	Power Sensor to X1 (RF OUT1)	between X1 (RF OUT1) and X5 (REV1)	Power Sensor to X11 (FWD)
Amplifier1-CDN	Power Sensor to X1 (RF OUT1)	between X1 (RF OUT1) and Power Sensor	

#### 3.4.2.2 Calibration Signal Paths for EM-Clamp

The same test setup and calibration as for CDN is used for EM-Clamp.

#### 3.4.2.3 Calibration Signal Paths for BCI

After calibration of CDN signal paths open the Hardware Setup for Injection Clamp (BCI).

Follow the instructions of the measurement procedure in chapter 3.4.1.2.

Choose the corresponding paths in the BCI hardware setup menu and use the following connections for calibration:

Signal Path	Setup Normalisation Measurement	Setup Calibration Measurement
Amplifier1- InjectionClamp	Power Sensor to X1 (RF OUT1)	between X1 (RF OUT1) and Power Sensor
MonitoringClamp- RFSensor1	Power Sensor to X1 (RF OUT1)	between X1 (RF OUT1) and Power Sensor

Alternative: If the same cable is used from Amplifier1 to CDN and to Injection Clamp, the attenuation value Amplifier1-CDN can be used also in the BCI setup. To do this open the selection of attenuation files with a right mouse click on the connection between amplifier and injection clamp and choose Amplifier1-CDN from the list.

### 3.4.2.4 Calibration of monitoring clamp for BCI

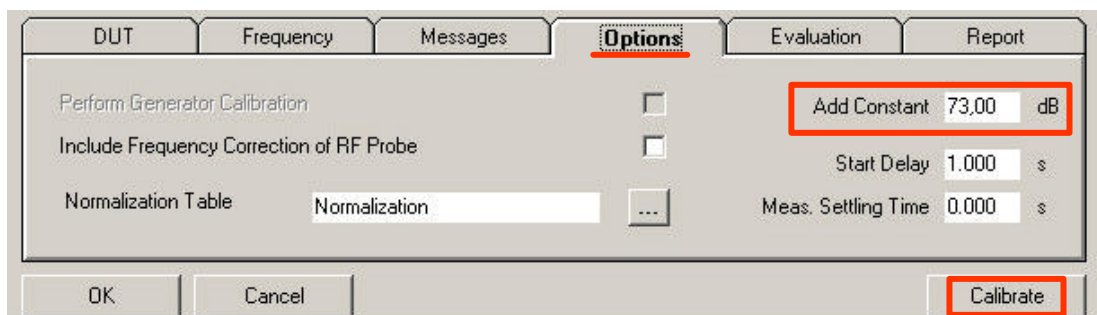
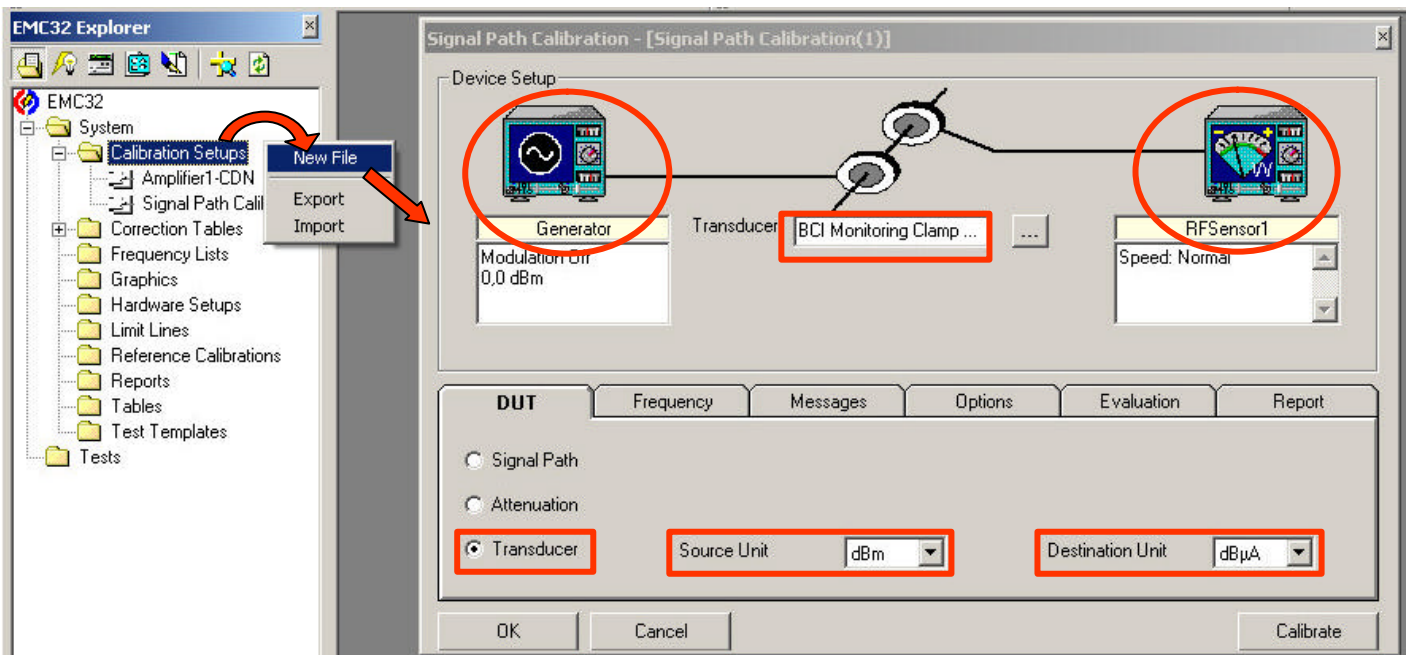
It is recommended for BCI to use a monitoring clamp besides the injection clamp. This monitoring of the injected RF level improves system accuracy.

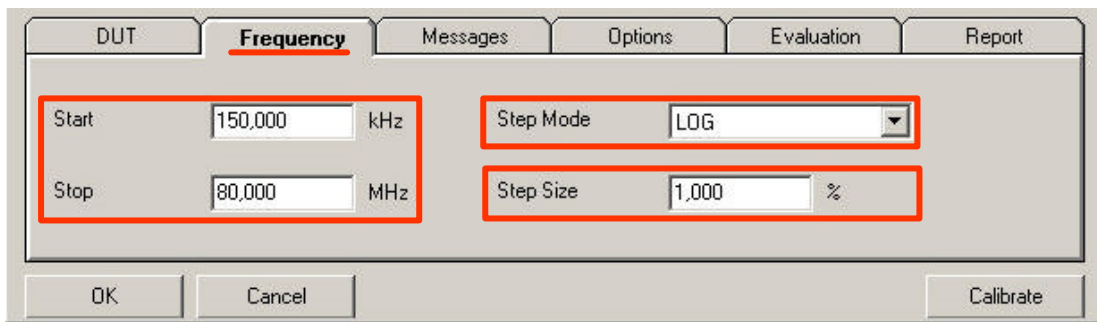
**Note:**



*An alternative procedure to the measurement described here is the import of manufacturer's calibration data. The procedure is defined in the EMC32 Help / Application Notes /EN61000-4-6*

Open the transducer calibration by a right click on Calibration Setups in the explorer and the item "new file".





Set the following parameters:

Parameter	Value	Remark
Type of DUT	Transducer	
Signal Source	Generator	Right click on icon
Transducer Name	Example: BCI Monitoring Clamp F-52	User defined
Signal detection	RFSensor1	Right click on icon
Source Unit	dBm	Unit of signal detection
Destination Unit	dB $\mu$ A	Unit of value to be monitored (Injected current)
<b>Sheet Options:</b>		
Add Constant	73 dB	Conversion factor from dBm to dB $\mu$ A
<b>Sheet Frequency:</b>		
Start	150 kHz	
Stop	80 MHz	
Step Mode	Log	Default setting
Step Size	1 %	

Remark: The test level is measured by the monitoring clamp as current value (dB $\mu$ A). It is automatically converted into a voltage value based on a impedance of 150 ohms by the software. This procedure is defined in IEC/EN61000-4-6, subclause 7.4.

Press calibrate to start calibration.

The calibration itself is carried out in the same way as the cable calibration. The monitoring clamp is placed in its calibration fixture for calibration.

### 3.5 Reference Calibration Conducted

#### 3.5.1 General Information

Most Susceptibility Measurements are performed using the **substitution method** (for example EN 61000-4). A calibration is run in the first step to determine which input power into the transducer is necessary to get the required stress level at the location of the EUT. The stress level is measured in this case with the power meter (reference measurement). The received measurement results are stored in the Reference Calibration File. During the real EUT measurement the sensor is then replaced by the EUT. Now a forward power with a level stored in the reference calibration file is fed into the transducer to generate the required stress level.

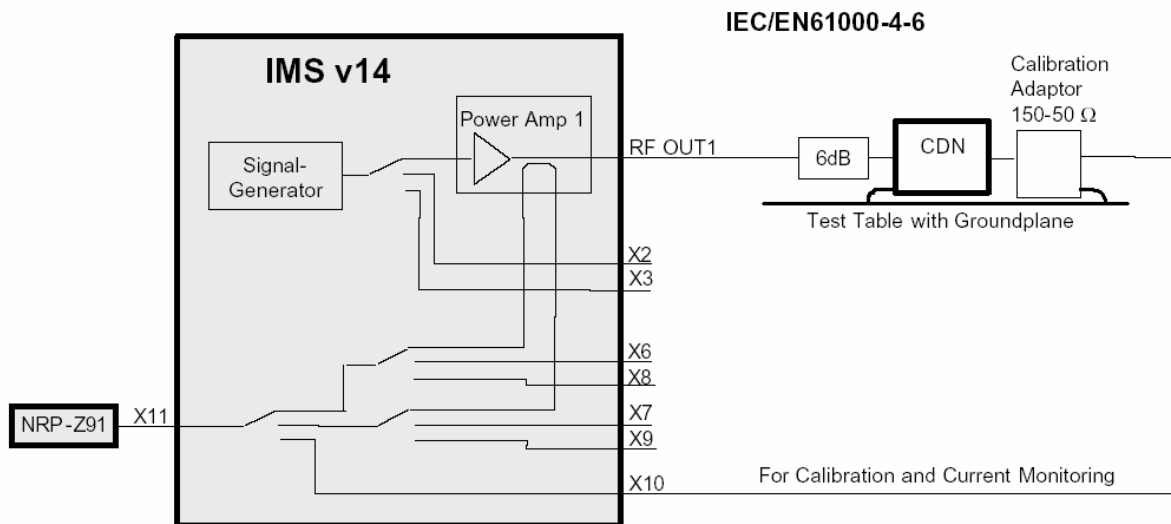
Reference Calibration Tables are generated with the Test Method "Reference Calibration" during an EMS measurement run.

#### 3.5.2 Reference Calibration CDN

##### 3.5.2.1 Hardware Setup

Install all cables according to the measurement setup including 6 dB attenuator and CDN. The setup should be the same as for the EMS measurements later.

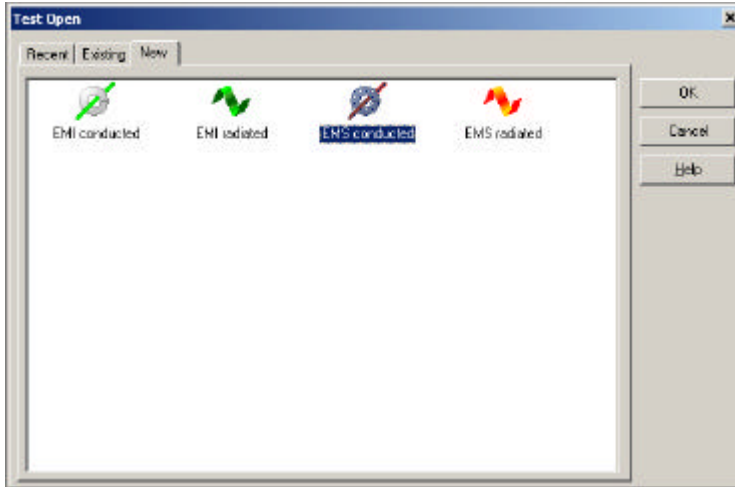
Connect the 150-50 Ohm adaptor to the CDN via a suitable adaptor. Connect the ground connections of the CDN and the 150-50 Ohm adaptor to the test table.



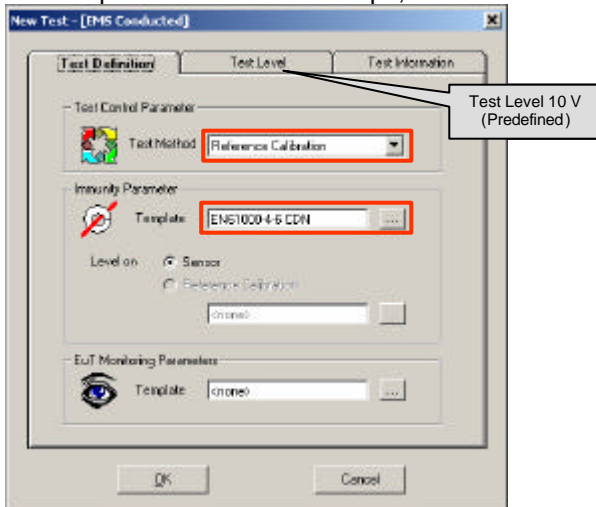
Calibration Setup CDN

### 3.5.2.2 Reference Calibration

- Open a new test via the menu File – Test open/new
- Select EMS Conducted in the folder New



- Select test method Reference Calibration
- Set the test template EN61000-4-6 CDN  
Remark: The Test Template defines the settings of a test. Therefore it is useful to define different test templates for different setups, EUTs or transducers (e.g. types of CDN).

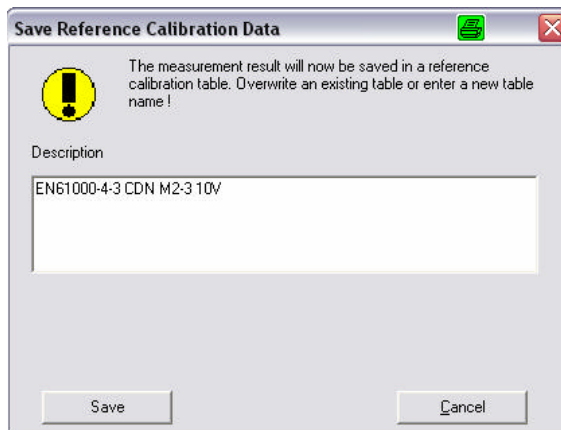


- Remark: The standard test level 10 V is predefined in the folder Test Level. If only tests for e.g. 3 V will be carried out, it may be adjusted.
- Enable test mode by OK.
- Start test by pressing the button Start Forward in the test control toolbar





When the test is finished for all frequencies the following dialog for storing the reference calibration file appears:



**Tip:**

The name of the reference calibration file should always give a reference to the name of the antenna and the immunity level (example: EN61000-4-6 CDN M2-3 10V)

- Finish the measurement modus



- Repeat this procedure for all CDNs and EM-Clamp, that shall be used in the system.

Now the system is ready for conducted measurements.

**Note:**



***For each transducer (e.g. different CDNs, EM-Clamp) a separate reference calibration file must be created and used for the test.***

## 4 Measurement Example

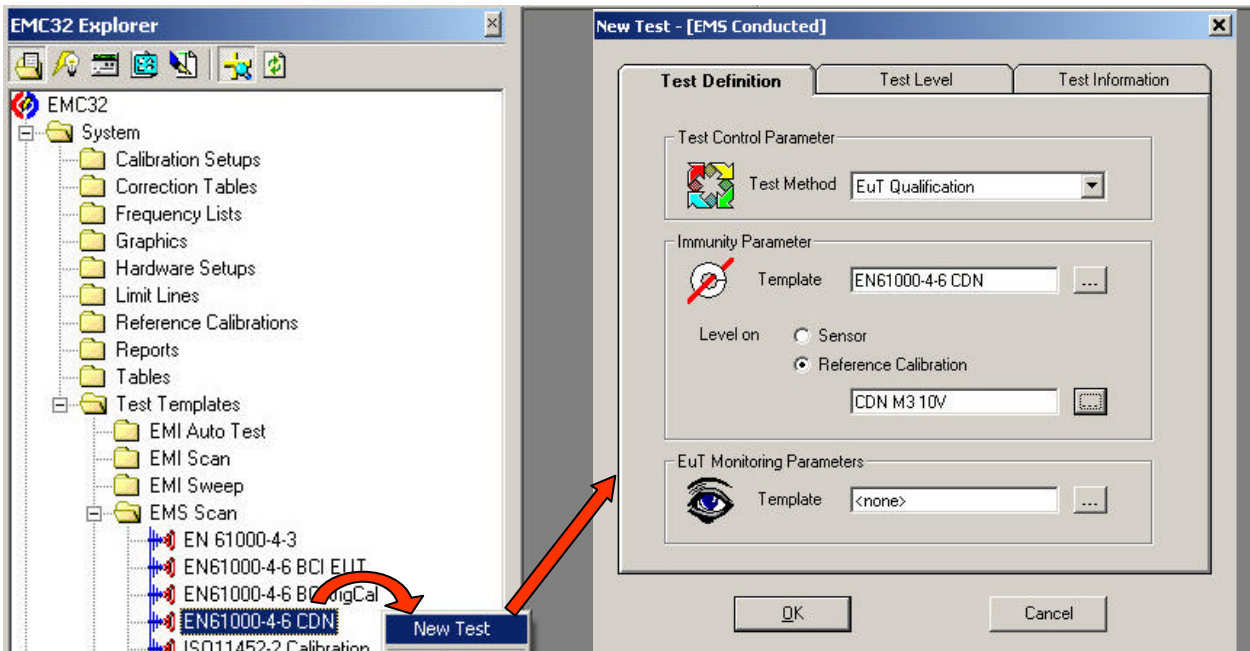
### 4.1 Measurement Example

The test is based on the test template, which was already used in the reference calibration. This test template contains all the basic information like type of test, frequency range, dwell time.

**Note:**

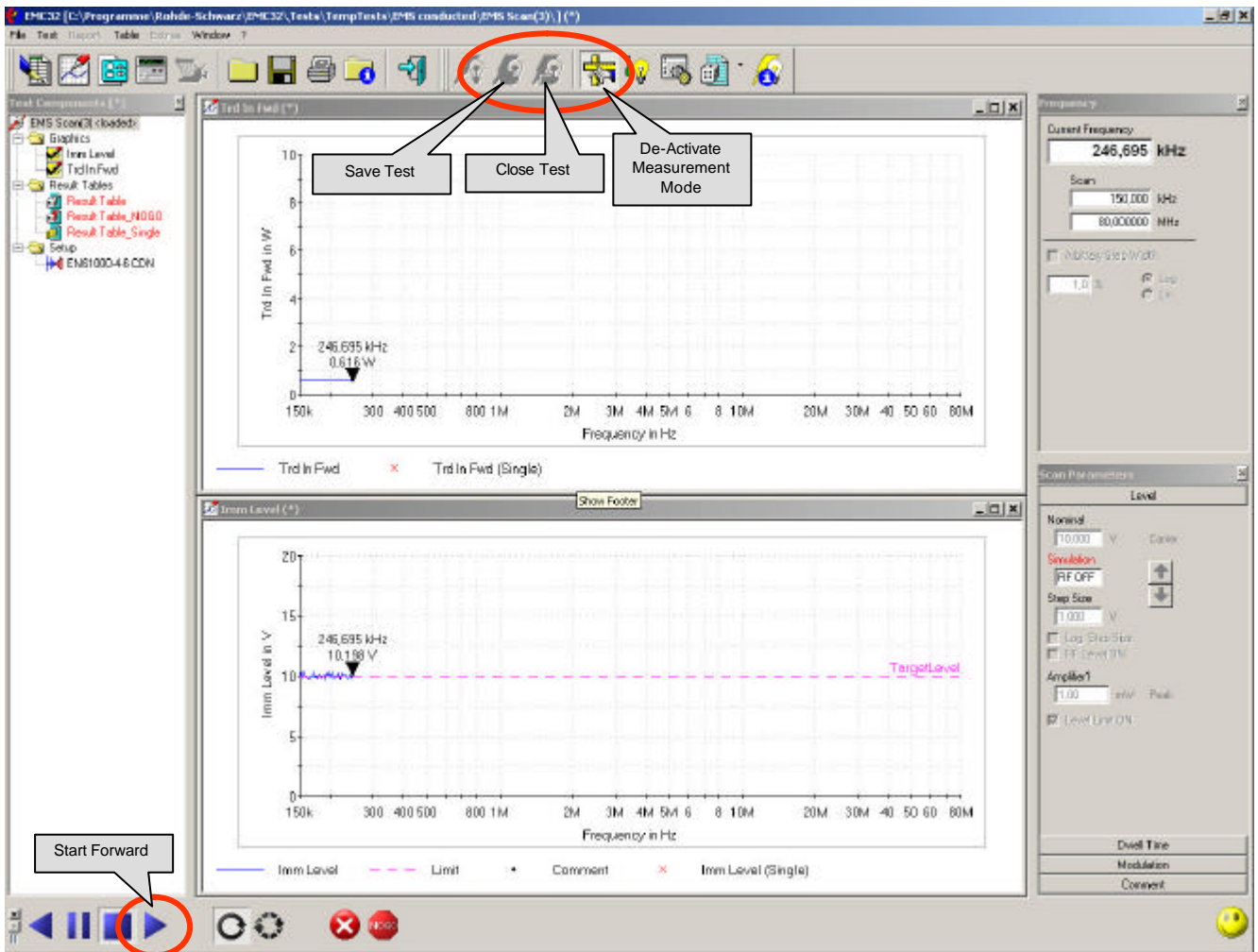


*The predefined test templates contain the settings according to the standards.*



- Open a new test by a right click on the Test Template (EN61000-4-6 CDN) in the explorer and the item “new file”.
- Select the Test Method “EUT Qualification”
  - Remark on the test methods:
    - EUT Qualification carries out the measurement according to the defined test level whether a NoGo is detected or not.
    - EUT Susceptibility automatically detects the threshold limits of the EUT. This means in case of a NoGo the test level is lowered until a Go is detected. It is raised again until the NoGo is detected again. These test level values are stored (EUT monitoring recommended).
- Select Level on Reference Calibration and the appropriate file stored in the step reference calibration.
- For setting of automatic EUT monitoring please see separate application note.

- In the sheet Test Level set the Test Level (typical 10 V)
- Click OK to start test mode.

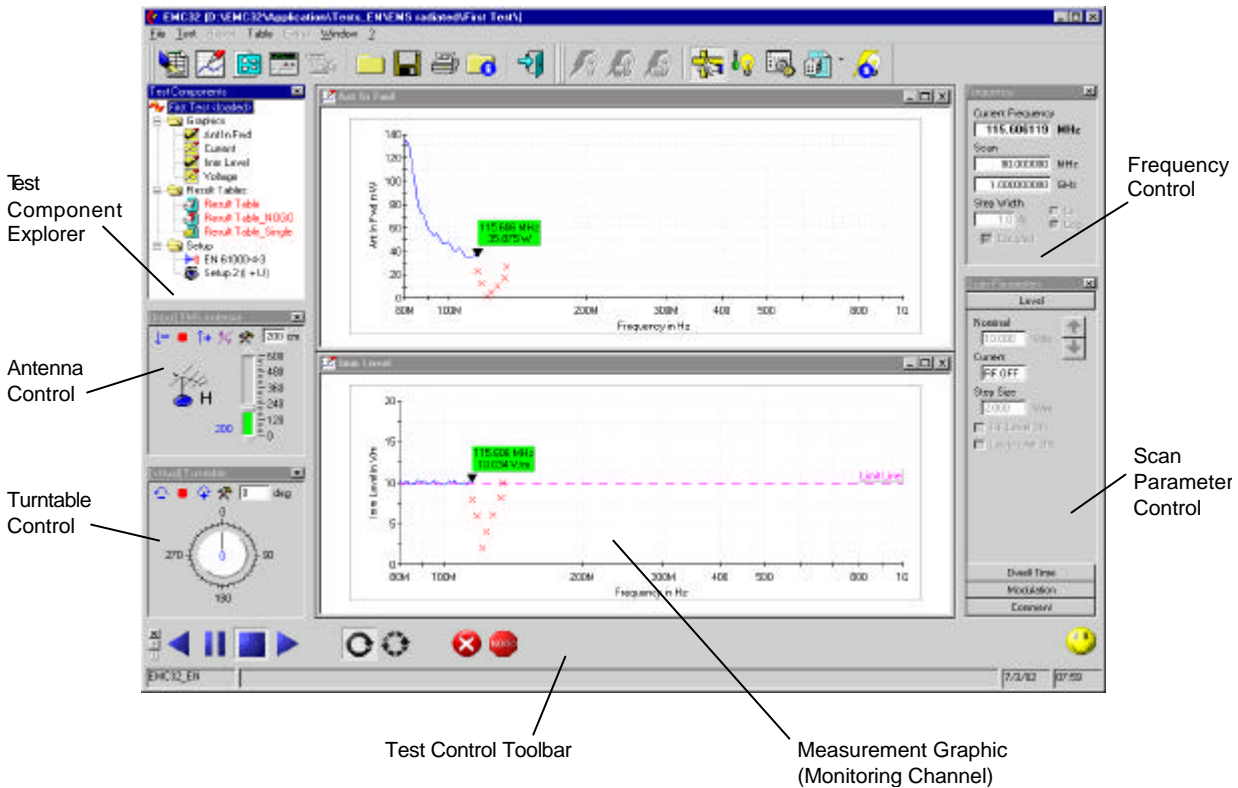


If you press the Start Forward button, the test is run automatically.

After the test is completed, de-activate the measurement mode, save and close the test. For report generation please refer to the chapters in the Getting Started manual of the EMC32.

## 4.2 Control Elements during EMS-Test

Components of the Test Mode:

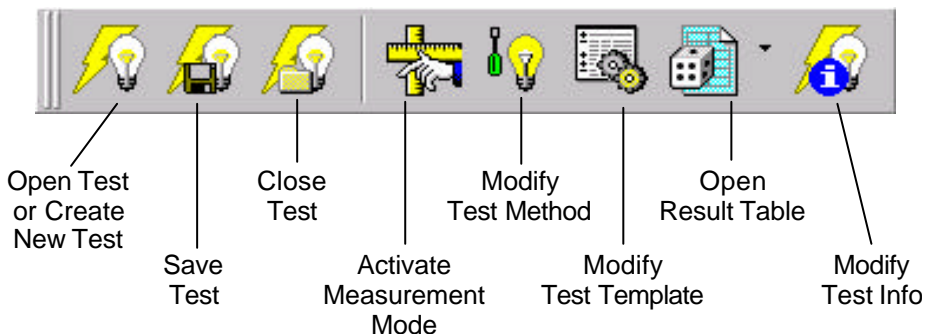


Remark: Antenna and turntable control are not visible for conducted measurements

**In the following the control elements and possibilities during a test are described in more detail:**

### **Test Toolbar:**

The following section gives a short introduction to the functionality of the symbols in the Test Toolbar.



### **What is the meaning of Measurement Mode?**

A test can be loaded for two purposes: running a new measurement or doing additional analysis with the goal of making a report printout of the measurement results.

For this, EMC32 distinguishes the **Measurement Mode**, used for running a measurement, and the **Analysis Mode**, where the elements for running a measurement are not shown. Switching between the two modes is done via the main menu entry Test → Meas. Mode, by pressing the **F4** key or by clicking on the corresponding symbol in the *Test Toolbar*.

When a new Test is created no result data are available for analysis. Because of that the software immediately activates the measurement mode. Otherwise an existing test is loaded and the software switches into the Analysis Mode. Here the measurement mode must be activated explicitly to repeat or continue the measurement.

In the Measurement Mode additional controls are added to the user interface of EMC32.

**Note:**



**Most settings can be modified in de-activated Measurement Mode only. Because these new settings change the measurements, a new test is created afterwards.**

**Note:**



**In the test folder a copy of the test template is stored. Therefore changes by the button Modify Test Template in the toolbar only modifies the template and settings for this test.**

**Test Component Explorer:**

The following section gives a short explanation of the functionality of the Test Component Explorer.

Start Point of the data tree of all available files in a Test

Available Measurement Graphics

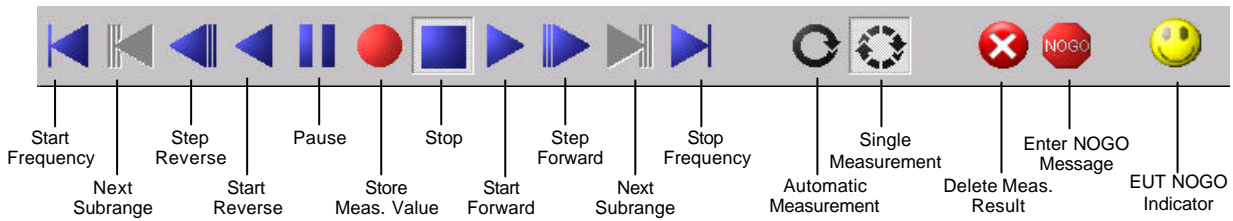
Available Reports

Available Measurement Result Tables

Available Test Setups (Templates)

**Test Control Toolbar:**

The following section gives a short introduction into the functionality of the Test Control Toolbar. It is used for the control of the measurement run and the switching of the measurement mode (automatic, single). During an automatic measurement only some of the symbols shown here are displayed.

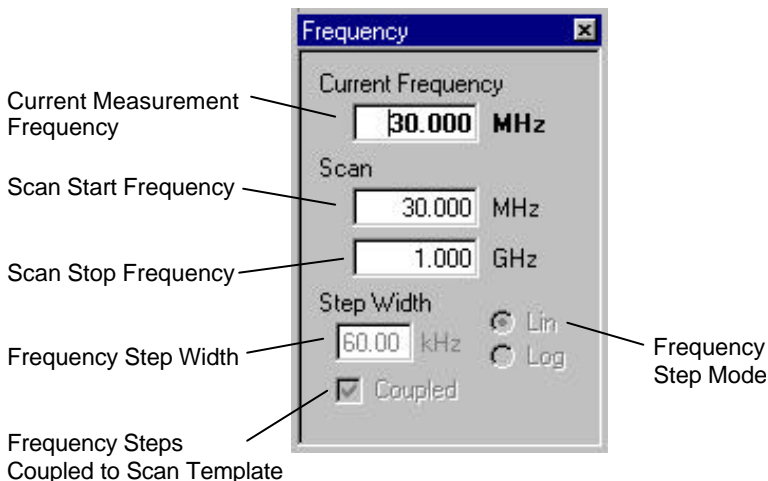


The following elements are only visible in the single measurement mode in the Test Control Toolbar:

- Jump to the start or stop frequency
- Next subrange
- Step reverse, forward
- Store measurement value

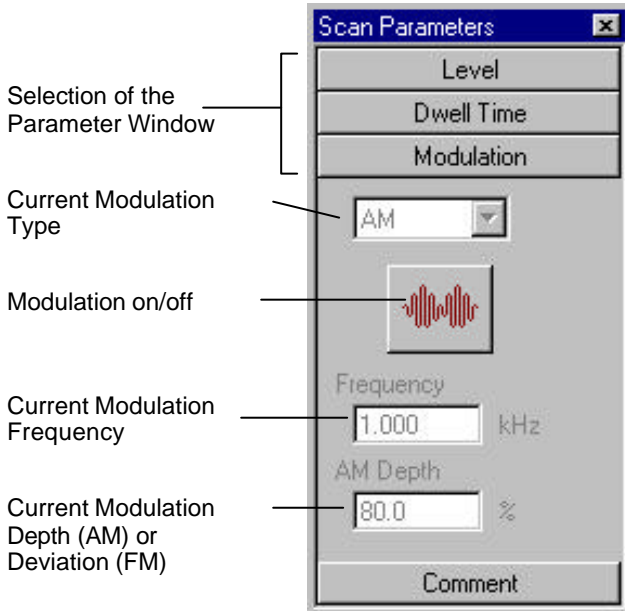
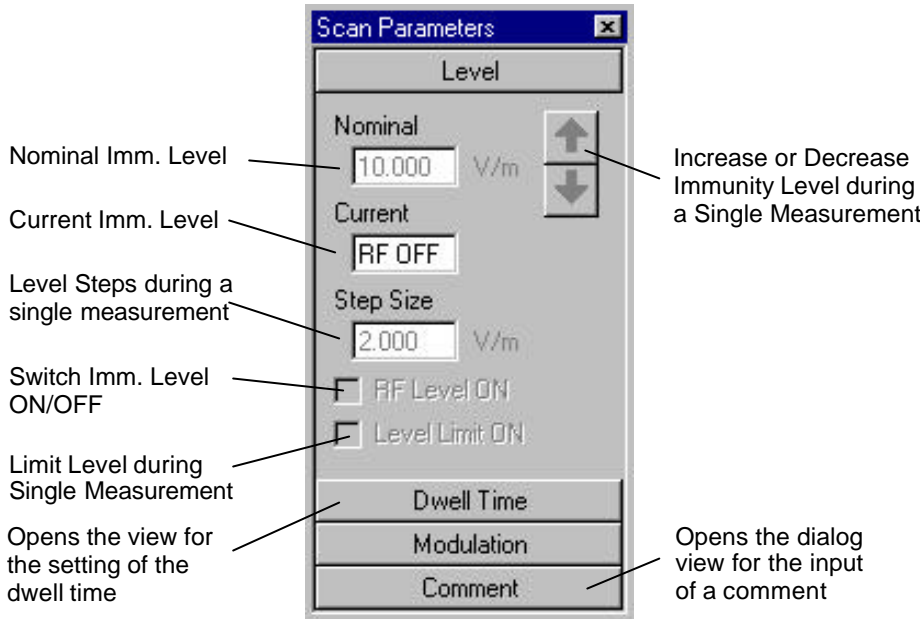
### **Frequency Control**

The following section gives a short explanation of the functionality of the Frequency Control element. The operator may enter both the frequency where the measurement should be started and the frequency range in which the measurement should be performed (only limited by the frequency range defined by the EMS Scan Template).



### **Scan Parameter Control:**

The following section gives a short explanation of the functionality of the Scan Parameter Control element. During an automatic scan measurement it mainly displays the settings stored in the Scan Template. During a Single Measurement it may be used for the variation of the stress level parameters (refer to section 4.2.2. Running a Single Measurement).







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